AMENDMENT

(Amendment under the provisions of Article 11 of the law)

To: Mr. Takahiro Inoue, Patent Office Examiner

1. Indication of International Application: PCT/JP2004/006656

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4. Subject of Amendment

Specification and Claims

5. Contents of Amendment

(1) In line 15, page 2 of the specification, amend "provided" to read "provided, with said die formed with a through-hole longitudinally extending through this die and inwardly of said inner layer tube molding passage, said tube being externally fitted on a core material forwardly passing through said through-hole".

(2) In line 18, page 2 of the specification, amend "forwardly from" to read "at".

(3) In line 19, page 2 of the specification, amend "opened" to read "opened, and said inner extrusion port of said inner layer tube molding passage is disposed close to the front end opening radially constituting the front end of said through-hole".

(4) In lines 20-25, page 2 of the specification, delete "In addition, …… through-hole.".

(5) In line 26, page 2 of the specification, after "in said

invention," add "in an extrusion molding apparatus for a resin multi-layer tube, comprising a cold-curing device for cold-curing said multi-layer tube molded by being passed through said inner and outer layer tube molding passages, and a take-up device for taking up said multi-layer tube cured by this cold-curing device, at a predetermined speed,".

(6) In line 27, page 2 of the specification, amend "provided" to read "removably fixed to said die".

(7) In line 9, page 3 of the specification, amend "provided" to read "provided, with said die formed with a through-hole longitudinally extending through said die and inwardly of said inner layer tube molding passage, said tube being externally fitted on a core material forwardly passing through said through-hole".

(8) In line 12, page 3 of the specification, amend "forwardly from" to read "at".

(9) In lines 3-7, page 4 of the specification, amend "in addition, added to said invention, ... said inner layer tube" to read "further, said inner layer tube".

(10) in line 8, page 4 of the specification, amend "may." to read "is.".

(11) In line 9, page 4 of the specification, amend "with the arrangement thus made," to read "for this reason,".

(12) In line 20, page 4 of the specification, after "in said invention," add "in an extrusion molding apparatus for a resin multi-layer tube, comprising a cold-curing device for cold-curing said multi-layer tube molded by being passed through said inner and outer layer tube molding passages, and a take-up device for taking up said multi-layer tube cured by this cold-curing device, at a predetermined speed,".

(13) In line 21, page 4 of the specification, amend "provided" to read "removably fixed to said die".

(14) After line 1, page 7 of the specification, add "with said die formed with a through-hole longitudinally extending through said die and inwardly of said inner layer tube molding passage, and a core material forwardly passing through said

through-hole has said tube externally fitted thereon".

(15) In line 3, page 7 of the specification, amend "forwardly from" to read "at".

(16) After line 4, page 7 of the specification, add "said inner extrusion port of said inner layer tube molding passage is disposed close to the front end opening radially constituting said front end of said through-hole.".

(17) In line 8, page 13 of the specification, amend "forwardly from" to read "at".

(18) In line 12, page 15 of the specification, amend "achieved" to read "achieved".

(19) In line 7, [1] of Claims, page 16, amend "provided" to read "provided, with said die (11) formed with a through-hole (24) longitudinally extending through said die (11) and inwardly of said inner layer tube molding passage (9), said multi-layer tube (2) being externally fitted on a core material (25) forwardly passing through said through-hole (24)".

(20) In line 11, [1] of Claims, page 16, amend "forwardly from" to read "at".

(21) In line 11, [1] of Claims, page 16, amend "opened" to read "opened, and said inner extrusion port (17) of said inner layer tube molding passage (9)is disposed close to the front end opening (26) radially constituting the front end of said through-hole (24)".

(22) Delete the sentences in [2] of Claims, page 16.

(23) Before line 1, [3] of Claims, page 16, add "in an extrusion molding apparatus for a resin multi-layer tube, comprising a cold-curing device (13) for cold-curing said multi-layer tube (2) molded by being passed through said inner and outer layer tube molding passages (9, 10), and a take-up device (14) for taking up said multi-layer tube (2) cured by this cold-curing device (13), at a predetermined speed,".

(24) In line 2, [3] of Claims, page 16, amend "provided" to read "removably fixed to said die (11)".

(25) Amend [3] and [4] of Claims, page 16, such that they are dependent on only [1] .

6. List of Attached Papers
   (1) Page 2 and page 2/1 of the Specification
   (2) Page 3 and page 3/1 of the Specification
   (3) Page 4 of the Specification
   (4) Page 7 and page 7/1 of the Specification
   (5) Page 13 of the Specification
   (6) Page 15 of the Specification
   (7) Page 16 of Claims

It is not easy to ensure that their respective wall thicknesses obtain desired values. Furthermore, the resins which are materials for them differ in hardness at ordinary temperature from each other. For this reason, the harder resin presses the softer resin, unintentionally causing large deformation. Consequently, with the extrusion molding apparatus described above, it is not easy to ensure that the respective wall thicknesses of said inner and outer layer tubes are accurate.

MEANS FOR SOLVING PROBLEMS

[0007] The invention, which has been accomplished with the above in mind, has an object to ensure that the respective wall thicknesses of the inner and outer layers in the multi-layer tube molded by an extrusion molding apparatus are further accurate.

[0008] The invention provides an extrusion molding apparatus for a resin multi-layer tube, comprising a plurality of extruders for thermally melting and extruding resins of different kinds, and a die formed with an inner layer tube molding passage for forwardly passing therethrough the resin extruded from one of these extruders to enable the molding of an inner layer tube, and an outer layer tube molding passage for forwardly passing therethrough the resin extruded from the other extruder to enable the molding of an outer layer tube which is to be externally fitted integrally on said inner layer tube, said die enabling the molding of a multi-layer tube by these inner and outer layer tubes, said die being formed with a through-hole longitudinally extending through said die and passing inwardly of said inner layer tube molding passage, said tube being externally fitted on a core material forwardly passing through said through-hole, wherein

inner and outer extrusion ports constituting the respective front ends of said inner and outer layer tube

molding passages are disposed radially close to each other and are opened at the front end surface of the die separately from each other, and said inner extrusion port of said inner layer tube molding passage is disposed close to the front end opening radially constituting the front end of said through-hole.

[0009]

[0010] Further, in said invention, in an extrusion molding apparatus for a resin multi-layer tube, comprising a cold-curing device for cold-curing said multi-layer tube molded by being passed through said inner and outer layer tube molding passages, and a take-up device for taking up said multi-layer tube cured by this cold-curing device, at a predetermined speed,

another die disposed forwardly of said die and having a die hole communicating with said inner and outer extrusion ports may be removably fixed to said die.

[0011] Further, in said invention, the front vicinity of said passage may be radially outwardly opened.

EFFECTS OF THE INVENTION

[0012] The effects of the invention are as follows.

[0013] The invention provides an extrusion molding apparatus for a resin tube comprising a plurality of extruders for thermally melting and respectively extruding resins of different kinds, and a die provided with an inner layer tube molding passage for forwardly passing therethrough the resin extruded from one of these extruders to enable the molding of an inner layer tube, and an outer layer tube molding passage for forwardly passing therethrough the resin extruded from the other extruder to enable the molding of an outer layer tube which is to be externally fitted integrally on said inner layer tube, said die enabling the molding of a multi-layer tube by these inner and outer layer tubes, said die being formed with a through-hole longitudinally extending through said die and inwardly of said inner layer tube molding passage,

said tube being externally fitted on a core material forwardly passed through said through-hole, wherein inner and outer extrusion ports constituting the respective front ends of said inner and outer layer tube molding passages are disposed radially close to each other and opened at the front end surface of the die separately from each other.

[0014] For this reason, when each resin is extruded from each extruder by the driving of each extruder, each resin is passed through each tube molding passage in said die, whereby inner and outer layer tubes are molded. Further, when each said resin is extruded from the inner and outer extrusion ports forwardly of the die, the outer layer tube is externally fitted integrally on said inner layer tube, whereby a multi-layer tube is molded.

[0015] Here, as described above, the inner and outer extrusion ports are disposed radially close to each other. For this reason, when each said resin is passed through each tube molding passage in said die and extruded forwardly from the inner and outer extrusion ports, said inner and outer layer tubes immediately after they are extruded forwardly from said inner and outer extrusion ports fit together and smoothly integrated without requiring relatively large radial deformation.

[0016] Furthermore, the inner and outer extrusion ports are opened forwardly from the front end surface of said die separately from each other, as described above. For this reason, when said inner and outer layer tubes fit together, these inner and outer layer tubes are suppressed from pressing each other. Consequently, these inner and outer layer tubes are prevented from being unintentionally deformed by their pressing each other.

[0017] As a result, the respective wall thicknesses of said inner and outer layer tubes in the multi-layer tube molded by the extrusion molding apparatus can be made

more accurate.

[0018] Further, said inner extrusion port of said inner layer tube molding passage is disposed close to the front end opening radially constituting the front end of said through-hole.

[0019] For this reason, by the driving of each said extruder, a multi-layer tube is molded as it is extruded from said die, and this multi-layer tube is externally fitted on said core material, so that an intermediate product is molded using this multi-layer tube and the core material.

[0020] Here, the inner extrusion port is disposed radially close to said front end opening, as described above. Furthermore, the inner and outer extrusion ports are disposed radially close to each other. For this reason, when said multi-layer tube is extruded forwardly of said die, the inner and outer layer tubes of said multi-layer tube immediately after their extrusion are, without requiring large radial deformation, externally fitted on the core material immediately after slipping out of the front end opening as it forwardly passes through said through-hole.

[0021] Consequently, the multi-layer tube in said intermediate product molded by said extrusion molding apparatus can have the respective wall thicknesses of the inner and outer layer tubes made more accurate.

[0022] Further, in said invention, in an extrusion molding apparatus comprising a cold-curing device for cold-curing said multi-layer tube molded by being passed through said inner and outer layer tube molding passages, and a take-up device for taking up said multi-layer tube cured by this cold-curing device, at a predetermined speed, wherein

another die disposed forwardly of said die and having a die hole for communicating with said inner and outer extrusion ports may be removably fixed to said die.

[0023] With the arrangement thus made, the multi-layer tube

extruded from said die is passed through said die hole, whereby the perfect circularity and radial dimensions can be finally determined. Consequently, the respective wall thicknesses of the inner and outer layer tubes in said multi-layer tube can be made more uniform with respect to each other in any peripheral portion, so that the multi-layer tube can be made more accurate.

[0024] Further, in said invention, the front vicinity of said outer extrusion port of said outer layer tube molding passage may be opened radially outward.

layer tubes. Said die is formed with a through-hole longitudinally extending through said die and inwardly of said inner layer tube molding passage, said tube being externally fitted on a core material forwardly passing through said through-hole.

[0030] Inner and outer extrusion ports constituting the respective front ends of said inner and outer layer tube molding passages are disposed radially close to each other and are opened forwardly of the front end surface of the die separately from each other. Said inner extrusion port of said inner layer tube molding passage is disposed close to the front end opening radially constituting the front end of said through-hole.

EMBODIMENTS

[0031] To describe the invention in more detail, embodiments thereof will be described with reference to the accompanying drawings.

[0032] In Figs. 1 - 3, the character 1 denotes an extrusion molding apparatus. This extrusion molding apparatus 1 is used for extrusion-molding a multi-layer tube 2 of circular section made of resin. This multi-layer tube 2 comprises an inner layer tube 2a constituting the inner layer thereof, and an outer layer tube 2b constituting the outer layer of said multi-layer tube 2 and externally fitted on said inner layer tube 2a to be integrally fixed to the outer peripheral surface of this inner layer tube 2a. Said multi-layer tube 2 is used, e.g., as a material for catheters and its outer diameter is 1.0 - 1.5 mm. Further, the arrow Fr in the figure indicates the forward direction of extrusion of the multi-layer tube 2 by said extrusion molding apparatus 1.

[0033] The extrusion molding apparatus 1 comprises a plurality (two) of first and second extruders 6 and 7 for thermally melting thermoplastic first and second resins 3 and 4 to enable their extrusion, a die 11 formed with inner and outer layer tube molding passages 9 and 10 through which

the first and second resins 3 and 4 extruded from these first and second extruders 6 and 7 are separately forwardly passed to enable the molding of the inner and outer layer tubes 2a and 2b of said multi-layer tube 2, a cold-curing device 13 for cold-curing by water said multi-layer tube 2 molded by being passed through said inner and outer layer tube molding passages 9 and 10, and an electrically driven take-up device 14 for taking up said multi-layer tube 2 cured by this cold-curing device 13, at a predetermined speed (for example, 2.5 - 10 m/min).

[0034] Said first and second resins 3 and 4 differ from each other in hardness at ordinary temperature. Further, the thermally melting of said first and second resins 3 and 4 is achieved by heating using a heater. Further, said first and second extruders 6 and 7 rotationally drive screws by an electric motor.

[0035] Said die 11 will now be described in more detail. Said inner and outer layer tube molding passages 9 and 10 are each in the form of a forwardly tapering frustum and are disposed on the same axis 16. Further, in the radial direction (orthogonal direction, hereinafter the same) of this axis 16, the inner layer tube molding passage 9 is disposed inwardly of the outer layer tube molding passage 10. The respective front ends of said inner and

tube 2b is molded. For this reason, as shown in Figs. 4 and 5, the inner and outer layer tubes 2a and 2b in the multi-layer tube 2 have their respective wall thicknesses and radial dimensions radially adjusted. Thereupon, the hardness and shape at any section of said multi-layer tube 2 along the longitudinal direction can be continuously gradually changed, a fact which is convenient for molding catheters.

[0056] According to the above arrangement, inner and outer extrusion ports 17 and 18 constituting the respective front ends of said inner and outer layer tube molding passages 9 and 10 are disposed radially of said axis 16 and close to each other and opened at the front end surface 19 of the die 11 separately from each other.

[0057] For this reason, when the resins 3 and 4 are extruded from these extruders 6 and 7 by the driving of said extruders 6 and 7, these resins 3 and 4 are passed through the tube molding passages 9 and 10 of said die 11, whereby inner and outer layer tubes 2a and 2b are molded. Further, when said resins 3 and 4 are extruded from the inner and outer extrusion ports 17 and 18 forwardly of the die 11, the outer layer tube 2b is externally fitted integrally on said inner layer tube 2a, whereby a multi-layer tube is molded.

[0058] Here, as described above, the inner and outer extrusion ports 17 and 18 are disposed radially close to each other. For this reason, when said resins 3 and 4 are passed through the tube molding passage 9 and 10 of said die 11 and extruded forwardly from the inner and outer extrusion ports 17 and 18, said inner and outer layer tubes 2a and 2b immediately after they are extruded forwardly from said inner and outer extrusion ports 17 and 18 fit together and smoothly integrated without requiring relatively large radial deformation.

[0059] Furthermore, the inner and outer extrusion ports 17 and 18 are opened forwardly from the front end surface 19

of said die 11 separately from each other, as described above. For this reason, when said inner and outer layer tubes 2a and 2b fit together, these inner and outer layer tubes 2a and 2b are suppressed from pressing each other. Consequently, these inner and outer layer tubes 2a and 2b are prevented from being unintentionally deformed by their pressing each other.

[0060] As a result, the respective wall thicknesses of said inner and outer layer tubes 2a and 2b in the multi-layer tube 2 molded by said extrusion molding apparatus 1 can be made more accurate.

[0061] Further, said inner and outer extrusion ports 17 and 18 extend substantially in parallel with each other along the direction of said axis 16.

so that the multi-layer tube 2 can be made more accurate.

[0069] Further, as described above, the front vicinity of said outer extrusion port 18 of the outer layer tube molding passage 10 is opened radially outward of said axis 16.

[0070] For this reason, as shown in Fig. 5, the outer diameter of the multi-layer tube 2 extruded from said die 11 can be optionally set in any section along the longitudinal direction, thus enabling the molding of multi-layer tubes 2 of various shapes.

[0071] Fig. 6 shows another embodiment of said inner and outer extrusion ports 17 and 18.

[0072] According to this, said inner and outer extrusion ports 17 and 18 gradually approach each other radially of said axis 16 as they extend forward.

[0073] For this reason, when said inner and outer layer tubes 2a and 2b immediately after they are extruded forwardly from said inner and outer extrusion ports 17 and 18 fit together, these inner and outer layer tubes 2a and 2b are quickly joined, integration due to mutual fixing is achieved more reliably.

[0074] In addition, what has so far been described is by way of illustrated examples. Said multi-layer tube 2 and tube molding passages 9 and 10 may be three- or more-layered. Further, any one of the inner and outer layer tubes 2a and 2b of the multi-layer tube 2 may have its hardness increased. Further, a gear pump may be interposed between said extruders 6 and 7 and die 11. Further, said flow adjusting valves 34 and 35 may be interposed between said extruders 6 and 7 and die 11.

[0075] Further, the invention may be achieved by suitably combining individual component members described above.

CLAIMS

[1] (After amendment) An extrusion molding apparatus for a resin multi-layer tube, comprising a plurality of extruders (6, 7) for thermally melting and extruding resins (3, 4) of different kinds, and a die (11) formed with an inner layer tube molding passage (9) for passing therethrough the resin (3) extruded from one extruder (6) of these extruders (6, 7) to enable the molding of an inner layer tube (2a), and an outer layer tube molding passage (10) for passing therethrough the resin (4) extruded from the other extruder (7) to enable the molding of an outer layer tube (2b) which is to be externally fitted integrally on said inner layer tube (2a), said die (11) enabling the molding of a multi-layer tube (2) by these inner and outer tubes (2a, 2b), said die (11) being formed with a through-hole (24) longitudinally extending through said die (11) and inwardly of said inner layer tube molding passage (9), said multi-layer tube (2) being externally fitted on a core material (25) forwardly passed through said through-hole (24), said extrusion molding apparatus for resin multi-layer tube being characterized in that

inner and outer extrusion ports (17, 18) constituting the respective front ends of said inner and outer layer tube molding passages (9, 10) are disposed radially close to each other and are opened at the front end surface (19) of the die (11) separately from each other, said inner extrusion port (17) of said inner layer tube molding passage (9) being disposed close to a front end opening (26) radially constituting the front end of said through-hole (24).

[2] (Delete)

[3] (After amendment) An extrusion molding apparatus for a resin multi-layer tube, comprising a cold-curing device (13) for cold-curing said multi-layer tube (2) molded by being passed through said inner and outer layer tube

molding passages (9, 10), and a take-up device (14) for taking up said multi-layer tube (2) cured by this cold-curing device (13), at a predetermined speed, said extrusion molding apparatus for a resin multi-layer tube being characterized in that

Said die (11) has removably fixed thereto another die (30) disposed forwardly of said die (11) and having a die hole (29) communicating with said inner and outer extrusion ports (17, 18).

[4] (After amendment) An extrusion molding apparatus for a resin multi-layer tube, as set forth in Claim 1, characterized in that the front vicinity of said outer extrusion port (18) of said outer layer tube molding passage (10) is radially outwardly opened.